CLAIMS

1. Method for the preparation of paper pulp from used papers previously disintegrated and put in suspension by a pulper, using the difference between the sedimentation speed of the particles under the effect of an artificial gravity field created by the rotation of the apparatus combined with the filtration actions, characterised by the combined and simultaneous accomplishment, in one single rotary apparatus, of the following stages:

a) Filtration of the pulp through a grate which retains the pulp and allows the major part of the water with small contaminants and mineral loads to pass, being that filtration aided by the force created by the acceleration resulting from the rotation of the apparatus.

b) Concentration and evacuation of the pulp at the periphery of the apparatus under the effect of the acceleration resulting from the rotation of the apparatus.

c) Clarification of the waters which pass through the grate by separation and elimination of the solid elements in suspension with density higher than 1 which sediment at the periphery of the apparatus under the effect of the acceleration resulting from the rotation of the apparatus.

d) Concentration and extraction of solid elements of density higher than 1 extracted from the waters.

2. Apparatus to perform the method described in claim 1 for the preparation of paper pulp from used papers, comprising the following components:

a) A body (1) rotating at high speed, driving together all components inside it, provided with a pipe located at the centre of the apparatus (2), being the pulp driven at the angular speed of the apparatus by means of blades (3) solidary with the body.

b) A feeding zone (4) of a grate (6) being the respective grate (6) provided with small holes which allow to retain the pulp while the major part of the waters and residual contaminants pass through the grate.

c) A zone (7) for the concentration of the fibres retained by the grate (6) located at the periphery of the zone (4),

d) Several apertures (8) located at the periphery of the apparatus to evacuate the thickened fibres in the concentration zone (7),

e) A water clarification chamber (16) to clarify the waters having passed through the grate (6), including apertures located at the periphery of the apparatus (20) for the evacuation of the solid elements having sedimented at the periphery and a central pipe (21) for the evacuation of the clarified waters.

3. Apparatus according to claim 2, according to which the grate (6) may also have a function of fractioning between short fibres and long fibres, with classification as a consequence of the grate hole size.

4. Apparatus according to claim 2 and characterized by the grate (6) having also a function of de-inking, i.e. separation between fibres and inks, with classification as a consequence of the grate hole size.

5. Apparatus according to claim 2 and characterized by the contaminants of density higher than 1 that migrate upstream of the grate (6) to the apparatus centre, being evacuated by a pipe located along the apparatus axis (22).

6. Apparatus according to claim 2 and characterized by the clarification zone (16) being comprised by separation cones to facilitate the separation and the migration of the solid elements present in the waters to be clarified.

7. Apparatus according to claims 2 and 6 and characterized by the separation cones of the clarification chamber (16) leading in their peripheral part to channels (17) for the evacuation of suspended matter crossing the filtrate inlet, these channels communicating with a filtrate evacuation pipe (18) leading to the concentration chamber the extracted suspended matter (19) and extracted by extraction nozzles (20).

8. Apparatus according to claim 2 and characterized by all or part of the suspended matter separated from the filtrates, and having eventually been submitted to a later treatment, or any other solid matter not present in the pulp at the apparatus inlet (2) being reintegrated into this pulp by means of a central pipe (13) freeing the elements in points (13b) located in front of the grate (6) in the peripherical part of the chamber (4).

9. Apparatus according to claims 2 and 8 and characterized by the grate (6) being provided with smaller size holes in the most peripherical part in order to limit the flow of the reintegrated matter through the grate by the tube (13), being such matter characterized by elements with size smaller than the fibres initially retained by the grate.

10. Method according to claim 1 characterized by the fact that the differential of the sedimentation speed created by the artificial gravity field allows the separation, the recovery and the concentration of the major parts of the cellulosic elements present in the filtrates that have passed through the grate (6).

11. Apparatus according to claims 2 and 10, characterized by the heavier elements, including the existing cellulosic elements, sedimenting in the sedimentation chamber (33) under the effect of the acceleration created by the apparatus rotation, and being extracted from the apparatus at its periphery by extraction nozzles (34).

12. Apparatus according to claims 2 and 10, which allows the recovery of the cellulosic elements having passed through the grate (6), characterized by comprising a zone (6b) upstream of the grate (6) where the heavy elements and the cellulosic elements are concentrated at the periphery (5), under the effect of the artificial gravity field created by the apparatus rotation, being the heavy elements and the cellulosic elements, led to the pipe (10) dimensioned in order to the flow speed is higher than the sedimentation speed of the cellulosic elements which are led to the apparatus centre to the pipe (14), while the heavier contaminants sediment to the periphery of the pipe (10).

13. Apparatus according to claims 2, 10 and 12 and characterized by the most peripherical part of the pipes (10) for fibre recovery comprising an aperture (11) aimed to separate the solid matter extracted from the filtrates, this aperture being crossed by a water counterflow fed by a pipe (12) with a flow rate adapted to avoid the fibre passage, the contaminants which cross the apertures (11)

being concentrated in the chamber (19) and evacuated by nozzles (20).

14. Method according to claim 1 characterized by the fact that the differential of the sedimentation speed created by the artificial gravity field combined with a grate with holes or slots allows a complementary action of elimination of contaminants with a size higher than the size of the fibres.

15. Apparatus according to claims 2 and 14, characterized by being provided with a grate (23) having a flat or conical shape and having calibrated slots or holes such that the fibres pass through the slots and/or holes; the solid elements that do not pass through the slots and/or holes are progressively led by the artificial gravity field to the periphery of the apparatus if they have a density higher than 1 and to the axis of the apparatus if they have a density lower than 1, the solid elements led to the periphery of the apparatus being evacuated by several nozzles (38) with a permanent or sequential aperture, the solid elements led to the axis of the apparatus being evacuated by a central pipe (22); water and other elements, including the cellulosic ones, having passed the grate (23) being led by the pipe (24) to the next stage of the method.

16. Apparatus according to claim 2 and characterized by the inlet flow rates of the pulp (2) and of the water outlet flow rates (21) being inverted in a regular fashion so that they ensure a counter-wash of the grates and avoid their clogging.

17. Apparatus according to claims 2 and 6, and characterized by the filtrate clarification being divided in two stages; the first one being a pre-clarification by

sedimentation in a chamber (33) and ensuring a function of separation of the bigger elements; the second stage ensuring a final clarification (16).

18. Apparatus according to claims 2 and 6, and characterized by the clarification zone (16) being divided in two zones working is series, both provided with cones and separated by a central conical wall (35).

19. Apparatus according to claims 2 and 6 and characterized by the separation cones being provided at their closest end in relation to the apparatus axis, and on their upper surface, with channels (36) crossing with clarified waters; having these channels the role of separation of particles and fluids of density lower than 1; allowing these channels the evacuation of these lighter elements to the central pipe (37).

20. Apparatus according to claims 2 and 17 characterized by the fact that the suspended matter separated during the clarification stage may be partially or totally directed to the pulp concentration chamber (7) and therefore reintegrated in the pulp, due to the presence of pipes or inclined deflectors (39) ensuring a communication of the chamber of sedimentation of the suspended matter extracted from the filtrates (33) with the chamber of pulp concentration (7), the aperture of these deflectors having the possibility of being fixed or variable in order to allow a re-mixing in optimal proportions of fibres and particles.

21. Apparatus according to claim 2 and characterized by the thickened pulp being collected after its extraction, in one or several tubes (44) bent in a snail shape whose inlets are located facing the aperture zone of the extraction

nozzles, and in order to progressively slow down the pulp by speed reduction in curved tubes (44), with the aim to limit the change of the physical characteristics of the fibres when submitted to important mechanical stresses.

22. Method according to claim 2 and characterized by certain non-thickened semi-liquid wastes being treated, for example the foams of a de-inking cell, ensuring their thickening and the residual water clarification, being this treatment ensured by the addition of a feeding zone of the wastes to be treated by a central pipe et leading these wastes to the water clarification zone.

23. Method according to claim 2, characterized by the fact that the previously treated pulp may be introduced at the apparatus centre and extracted from the apparatus by the addition of a supplementary grate according to a working principle identical to the filtration grate (6).

24. Apparatus according to claims 2 and 14 and characterized by the fact that the filtration grate (23), with slots or holes, is conical and its inclination is characterized by having on or more angles «ladder wise» (28) in order to avoid the solid elements accumulating along the grate.

25. Apparatus according to claims 2 and 14 and characterized by the fact that the openings (41) (holes or slots) have a radial direction and a conical inlet (40), the conical inlets of two adjacent openings meeting in order that no plane surface between two cones exists, and this in order to facilitate the orientation and the flow of fibres.

26. Apparatus according to claims 2 and 14 characterized by the openings (41) of the grate (23) being constituted by an

inlet cone (40) and an outlet cone (42) in order to facilitate the flow of fibres and avoid the clogging risk.

27. Apparatus according to claims 2 and 14 and characterized by one or several openings (29) being created in the sedimentation zone upstream of the grate (23) having slots/holes, in order to deviate a part of the water, these openings communicating by pipes with the clarification zone or with the feeding zone of the filtration grate (6), these openings being placed in a retracted position and having a conical shape in order to avoid the driving of the contaminants to be extracted by the nozzles (38).

28. Method according to claim 1 characterized by the fact that the differential of the sedimentation speed created by the artificial gravity field allows a preliminary and complementary action of big contaminants elimination.

29. Apparatus according to claims 2 and 28, which allows a first separation action of the big contaminants in a sedimentation chamber (25) located at the most peripherical part of the apparatus, characterized by:

a) an opening (22b) to separate the contaminants with a density lower than 1 which concentrate in the lowest part of the chamber (25) and connected to the extraction pipe (22),

b) an opening (26) to separate the contaminants with a density higher than 1, including fibres, which sediment at the periphery of the chamber (25) and connected to the pipes (27),

c) pipes (27) to lead water and cellulosic elements to the next method stage, having an inclination and section adapted in order that the cellulosic elements

will be taken by the flow and will not sediment by the openings referred at e),

d) a feeding of water collected at the middle of the chamber (25) to feed the pipe (27),

e) openings (30) located close to the junction point so that the heavy contaminants are separated by sedimentation, while the fibres are driven by the flow of the pipe (27),

f) a pipe leading the solid elements captured by opening (30) to an extraction nozzle (38).